# Update on the Large GEM prototype @ Uva
# &
# mTPC detector for the TDIS Experiment @ JLab

Kondo Gnanvo

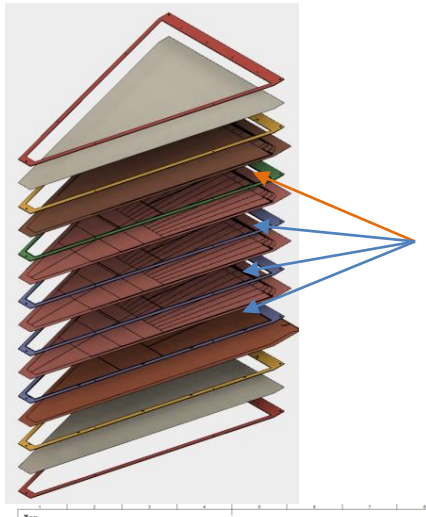
*EIC Weekly Meeting, March 26, 2018*

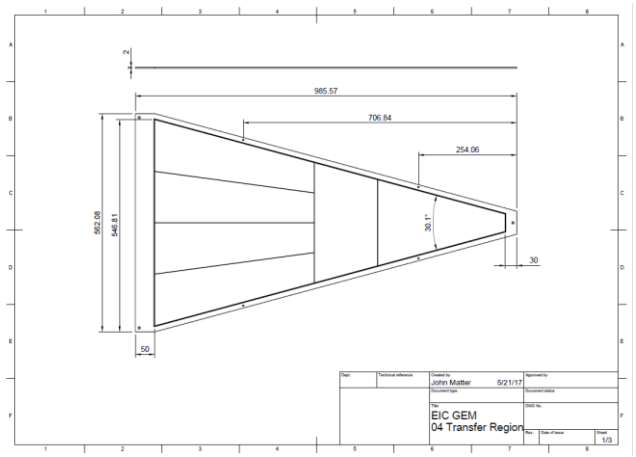
UNIVERSITY of VIRGINIA

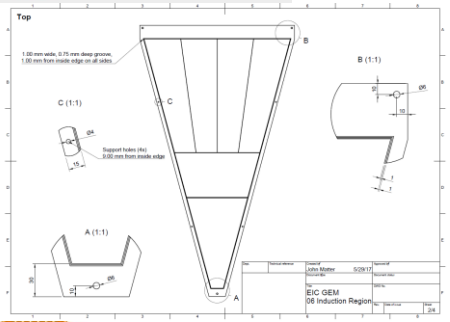
# 2 sets of support frames for the large GEM prototype

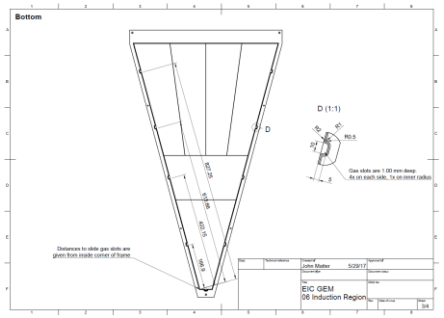
## High cost inner frames for GEMs with spacer grids

- **4 Inner Frames** with 300 µm spacers grid for GEM foils
- Precision machining of **PERMAGLAS** by RESARM (Belgium)
  - ⇨ High material and machining cost
- **Total cost for all 4 frames = 5.5 k$**
- Expected delivery in two weeks from today



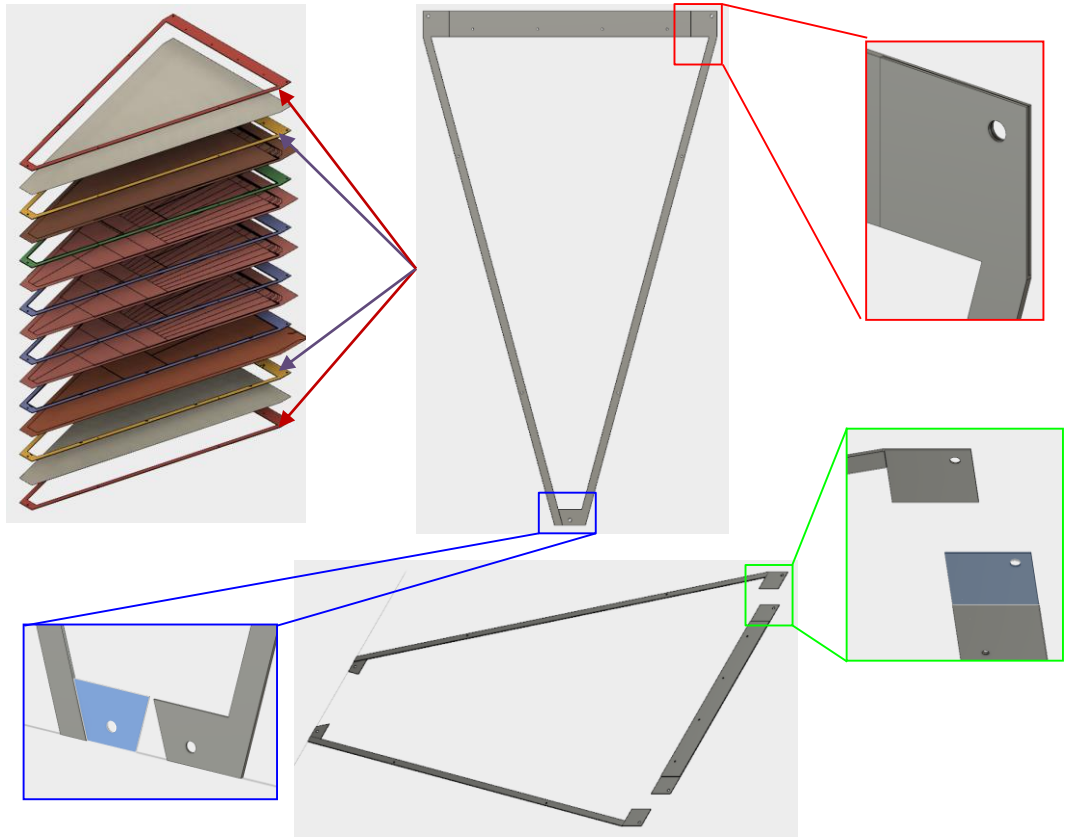



## Low cost outer frames without spacer grids

- **4 Outer Frames** for gas window foils without spacers grid
- Each frame made of four **G10** pieces cut out in local UVa machine shop
  - ⇨ Low cost: all parts for 4 frames from single 36” × 48” G10 plate
- **Total cost = 92 $ (material) + UVa machine shop labor**
- All part for already produced and glued in our lab



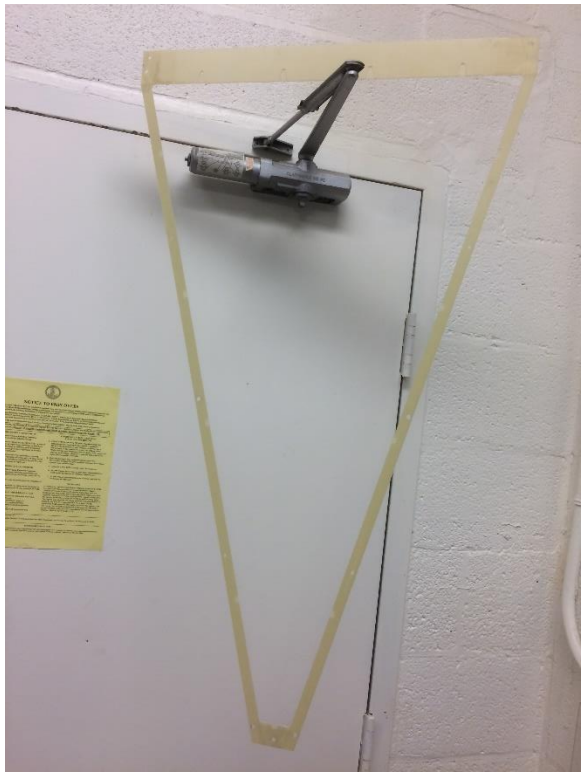
# Low cost frames for the large GEM prototype

parts for 4 frames: Machine shop

Set of 3 pieces for 1 frame

Gluing in Detector Lab

Final Frame



Plan for the prototype assembly

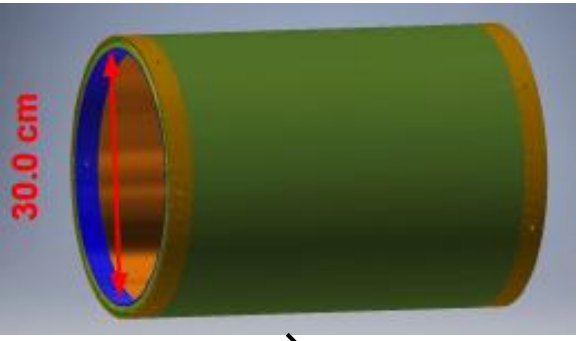
- **This week:** Sand and glue to the gas window foils to the low cost frames
- Mechanical stretcher for EIC GEM prototype stretcher: ⇨ we just modified design of the PRad stretcher to accommodate the size of the EIC prototype
  - drawings sent to the machine shop for the modifications ⇨ expect delivery in about two weeks from now
- **2 ~ 3 weeks time scale (mid April):** We should start the assembly of the chamber after delivery of the high cost frames and the mechanical stretcher
  - Assembly should be completed by **end of April**

# mTPC detector for the TDIS Experiment @ JLab

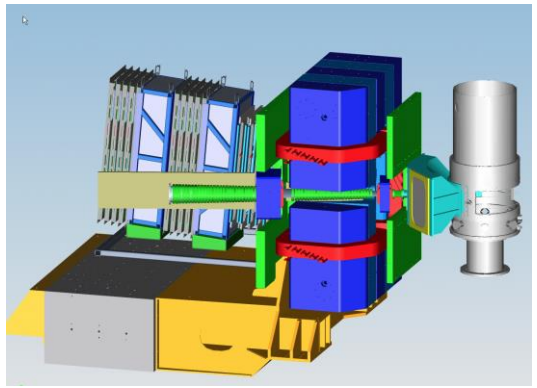
UNIVERSITY of VIRGINIA

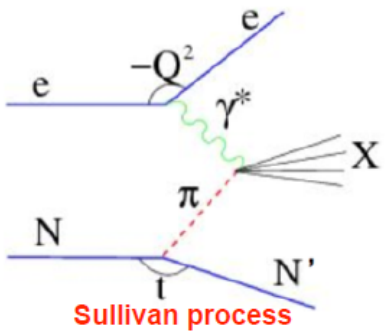
# Tagged DIS Measurement with RTPC and SBS

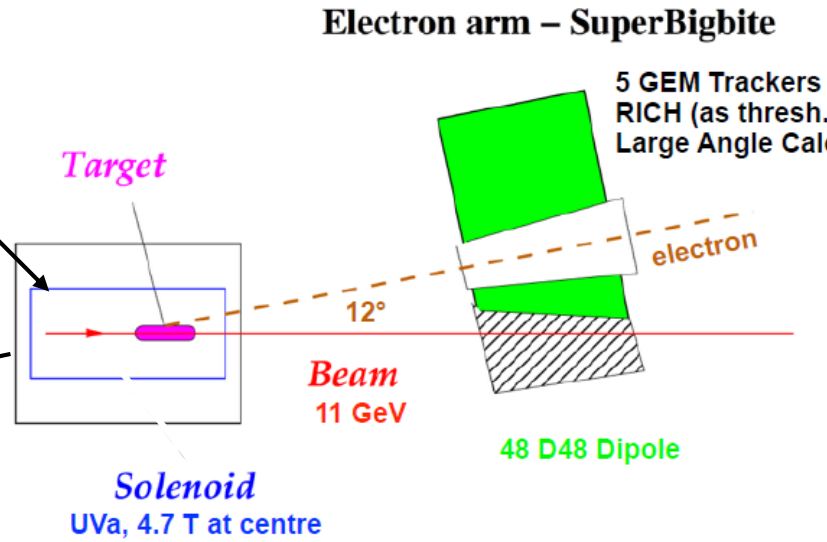
**Low momentum proton recoil / spectator:**
Original idea: Radial TPC (RTPC) a la BoNuS




- Measure DIS cross section, detecting high $W^2$, $Q^2$ $e^-$ scattered from $H_2$ and $D_2$ targets while tagging low-momentum recoil and spectator protons in coincidence
- Probe mesonic content of the nucleon structure function
- Access to pion structure function via Sullivan process N(e,e'N')X, described by $e^-$ scattering from pion cloud of nucleon N (initial nucleon at rest)





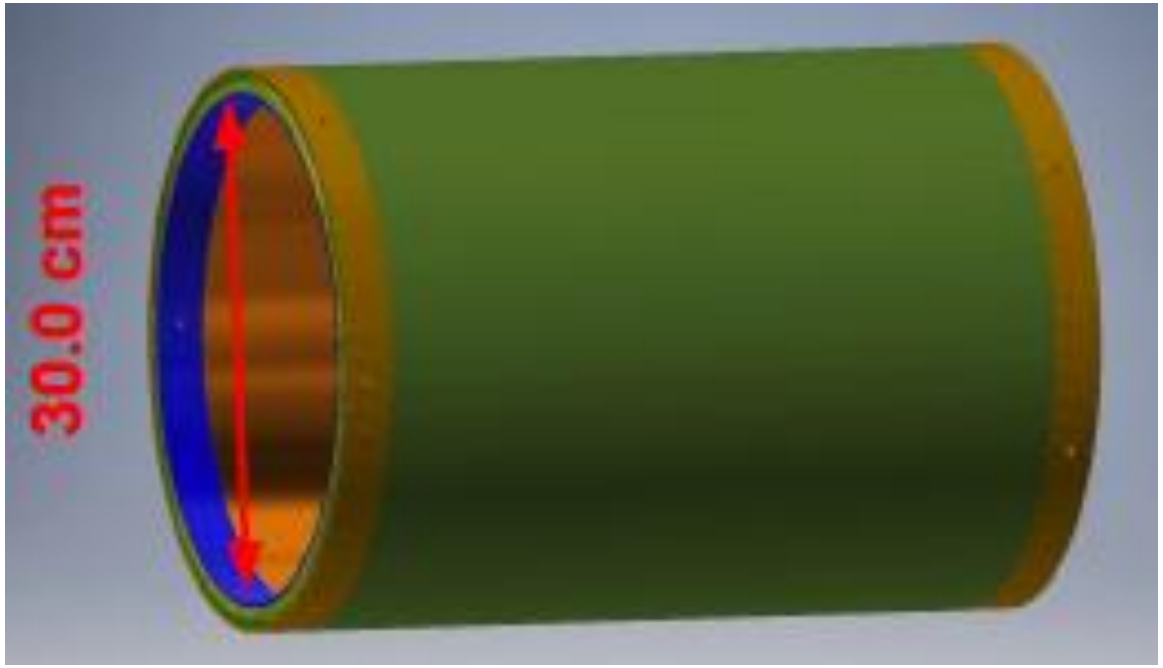




- Straw gas target (10μm Al cylinder; 5mm radius; 10μm Al end-windows; 400mm length; 77K; 1atm $H_2$ or $D_2$)
- Radial Time Projection Chamber for proton detection; large angular and kinematic coverage - detailed study of Sullivan process as a function of proton momenta and angles
- Solenoid (from UVa) surrounding target/RTPC
- SBS for $e^-$ detection
- HCal-J for neutrons in calibration runs

# TDIS mTPC Design

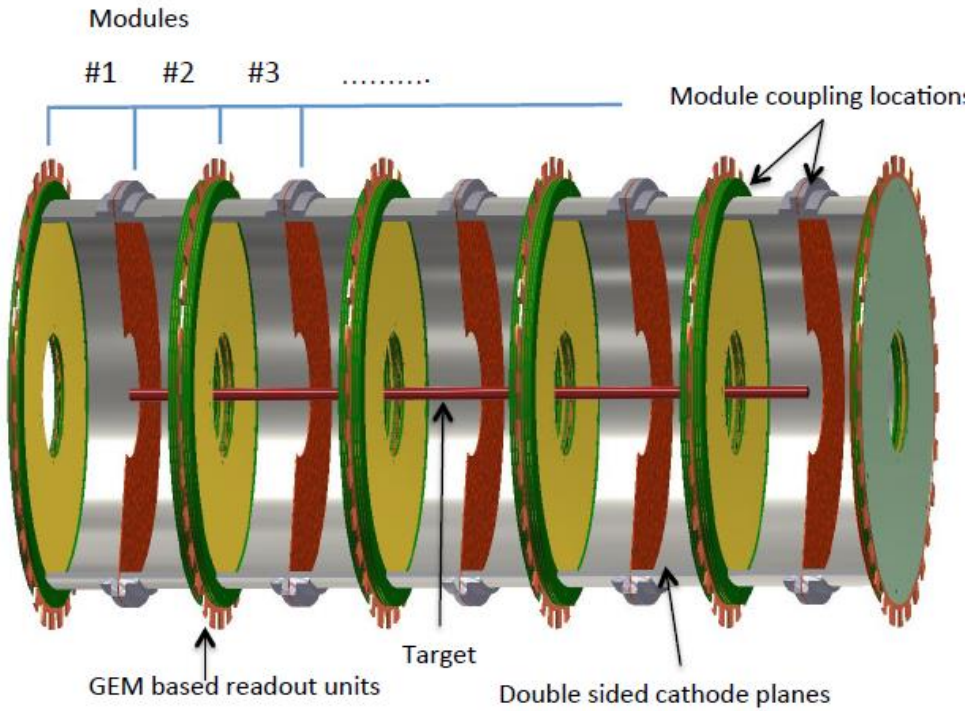
**Original idea: Radial TPC (rTPC a la BoNuS / BoNuS12**

- Fully cylindrical GEM chamber 10 / 30 cm inner / outer diameter
- Radial (10 cm) drift E-field perpendicular B-field ⇨ very long track
- **Pros:** No material in active volume, 20K$ electronic channels
- **Cons:** very high particle rate (~700 Mhz in the volume), drift time too long ~ 20 μs for track, challenges with Cylindrical Triple GEMs, momentum resolution etc …




**Current design: multiple TPCs (mTPCs) configuration**

- 10 GEM readout / 5 drift cathodes each shared by a pair of GEM readouts
- Each TPC block is a standard TPC ⇨ drift E-field (5 cm) parallel to B-field ⇨ shorter track and effective reduction of Moller e- background
- **Pros:** Particle rate ~ 70 MHz / GEM layer, shorter track (1 μs), Detector construction less challenging, momentum resolution
- **Cons:** a lot of material in the active TPC volume, need to minimize GEM material, 25K$ electronic channels



# TDIS mTPC GEM mdule Design